SEPTEMBER 1960

RADIO Retailing

SERVICE ENGINEER

Radio, Television and Audio Servicing

SERVICE ENGINEER

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Edited by W. Norman Stevens

Issued as a special supplement with "Radio Retailing"

In this issue:

SERVICE DATA SHEETS

TV162: Kolster-Brandes QV20/1 series television receivers.

TV163: Pye V200/V400 television receivers.

RI45: Ekco BPT351/Ferranti PT1030 portable transistor radios.

Big Screen Transistor TV

The Model 19P1 *Astronaut* now being sold by the American Motorola company looks basically no different from a conventional portable TV set, except that it uses a 19 in. sq. cornered picture tube. But if you looked inside you would see that it is a battery operated set running on 23 transistors and 12 diodes.

Performance-wise it stands comparison with the conventional portable, having a sensitivity of 15μV and a noise figure not exceeding 10dB. It weighs 14 lb. Power is supplied from a 5 lb. silver cadmium battery which will run for 5–6 hours before recharging is necessary, and it can be recharged at least 500 times (it automatically recharges on connection to the a.c. mains).

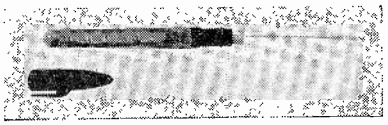
Instruments Merger

Cambridge Instrument Company Ltd., announce 100 per cent acceptance of their offer to the shareholders of Electronic Instruments Ltd., Richmond, Surrey, and the merger between the two companies has been completed. Electronic Instruments Ltd., will continue to trade under its own name and trade mark but both companies will benefit by the co-ordination of their research, production and sales facilities.

Electrolube DisPENser

A new convenient pocket size "pen" type dispenser has been introduced by Electrolube which enables the low resistance lubricant to be economically applied to otherwise inaccessible places. A sharp pull of the fountain-pen style cap automatically releases a thin 3 in. nylon "Snorkel" which, because of its flexibility, permits direct application of controlled drops when the reservoir body is squeezed or flexed.

Complete control of an individual spot, a drop, or a stream, is available at will, governed by the amount of pressure applied. Also, a removable plastic foam washer on the reservoir



top can be charged from the flexible tube and used to treat larger surface areas or small articles such as valve pins, screws, plugs, etc., without removal. The reservoir can be refilled when empty.

Two types of *DisPENser* are available from wholesalers: with Electrolube No. 1 (green cap) for non-arcing contacts, price 10s., each net trade; with Electrolube No. 2. (red cap) for arcing electrical contacts, price 12s., each net trade.

RADIOSPARES
NEW LINES

Latest additions to the Radiospares range include the T/T4 transformer designed to drive a 3-ohm speaker from a single OC72 under Class A conditions at supply voltages between 4·5–7·5V. This brings the number of transistor transformers up to four. The T/T4 is priced at 5s. 6d.

Also announced is a new range of stand-off and lead-through insulators nylon-loaded phenolic mouldings with "spire" clip mounting. Typical breakdown voltages for either type are 5kV d.c. on a 16 SWG panel, which permits safe working up to 1kV d.c. with an adequate safety margin for most applications. The average capacitance between centre conductor and a similar panel is approximately 4pF. The stand-offs sell at 3s. 9d. per half-dozen and the lead-throughs at 4s. 3d. per half-dozen.

Other new items include cut-lead car suppressors with moulded bakelite body and screwed inserts at each end to take ignition cable and a resistance value of 10kΩ. Price 1s. 4d. each. The heavy duty single PVC wire is now available in the additional colours green, blue, yellow and white, making seven in all. Price 5s. 9d. per reel. Also, the flush mounting coaxial outlets have been redesigned to fit standard conduit boxes (to BS1299 and BS1363).

Discontinued lines are the old type diecast flush mounting coaxial outlet plates and non-rev (with feeder) outlet plates and the range of standard mains droppers.

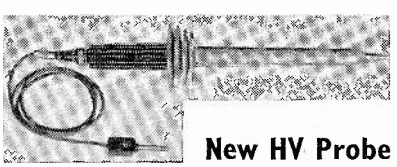
LITESOLD-ADAMIN RANGE

The soldering instrument range marketed by Light Soldering Developments Ltd., now covers 33 different models, under the trade marks *Litesold* and *Adamin*.

The *Adamin* low-voltage range is an entirely new product and has been introduced to supplement the *Litesold* type where minimum size coupled with high performance is essential. It is made on a completely different principle with the element inside the bit. There are eleven types, ranging from 4 watts to 24 watts, mostly for 6V operation but some for 12 and 24V and others for 6, 12, 24, and 50V. The bit diameters vary from 1/32 in. diameter to 3/16 in. diameter, prices being from £1 5s. to £1 13s.

Available for use with these soldering instruments are *Litesold* isolating transformers (LT6 for 6V output and LT12 for 12V output), an exclusive feature being a three-heat control which gives alternative bit temperatures for special work and high or low melting point solders. It also permits compensation for fluctuations in mains supply voltages. Price is 2 gns. for either type.

Among the accessories is a range of heat guards which are pushed over the body into the handle tube and afford protection against damage to heat sensitive components, insulations, etc., when working under inaccessible or congested conditions. It also gives added protection against accidental burns where it is not convenient to use a bench stand. Made of light spring steel wire, chromium plated, these heat guards are available in six models ranging in wattage from 10–55 and in price from 5s. to 8s.



New HV Probe

Heathkit have announced a new 30kV probe, the Model 336HV, which gives a multiplication factor of X100 when used with the V-7A valve voltmeter or others having an input impedance of 11 Megohms. It is finished in plastic with chrome fittings and sells at £2 7s. 6d. complete with leads and jack plug.

Service Viewpoint

AT times we hear talk of divorce. To be particular, in respect to the marriage of the sales and service sides of the business.

Those in favour of sundering this blessed union, point to other countries where, apparently successfully, many or all retail shops do not handle service, this being attended to by specialised independent servicing organisations.

The advocates become vocal when bjects like colour TV crop up; the line being that such complicated equipment is best dealt with in centralised service depots run by the makers.

But apart from such speculations, the segregationalists feel that service could be whisked away from the dealer anyway. The main props are:

(1) The service department attached to a retail organisation is often unprofitable.
(2) The department is troublesome, time-wasting.
(3) An independent service set-up could be more efficiently organised and less liable to pressure from outside (sales) influences.

Some of this may be true. But there remains one powerful over-riding advantage in the retail-shop-maintained service department, and this can be summed up in two words: Customer Contact.

Sales and Service

When a customer buys a set he likes to feel he can take it back for repair whence it came, rather than send it elsewhere. Even if the dealer himself farms out the repair, a third party is introduced and the bond with the customer is weakened.

The customer often has a sense of personal contact with his chosen dealer and has confidence that he will make a personal effort on his behalf. The fact that the set is just one of innumerable faceless fiends which flow in and out need not lead the dealer to disillusion the customer!

And a customer who keeps in touch, either by calling at the shop or by having engineers visit his home, is one who might well be induced to make further purchases. If the customer has to go elsewhere for service he is probably lost for future sales.

Although (as shown in *Service Engineer* articles) the service department *can* be run profitably, the dealer who only breaks even, or makes a small loss, and grumbles about it is only looking on one side of the picture.

For his service department is a aluable invisible asset.

By reason of it, customers maintain contact with the shop. By reason of the outside engineers' activities, the shop's name is kept in the customer's mind, paving the way for future sales. And courteous and helpful service engineers can often lead to recommendations and introductions to new customers. Goodwill is an abstract commodity but very real.

So even should the dealer be tempted to the conclusion that the service and sales departments are incompatible he should think twice before filing a petition on the grounds of mental cruelty. The two sides are interdependent. Given time, they might even learn to love each other.

GBC Screwdriver Torch

Novel service aid by GBC Electronics is the *Sunrise* flash torch in which the window has a central mounting to hold one of four different screwdriver blades to facilitate work in dark places. The torch, with four detachable driver blades and pouch-type plastic case sells at 10s., less battery.

New Levell Oscillators

Levell Electronics announce two new r-c transistor oscillators. The TG150 covers 1·5 c/s to 150 kc/s in five ranges (accuracy ±3 per cent) with a short-term drift of better than ±0·05 per cent after 30 seconds, and harmonic content of less than 0·1 per cent at 1 kc/s. Output is continuously variable up to 2·5V (into 600 ohms).

Housed in a steel case with carrying handle, measuring 10×6×4 in., the TG150 is priced at £27, including the two PP9 batteries. A leather shoulder strap case is available at £2 17s. 6d. extra.

The TG150M is similar except that it is fitted with an output meter calibrated 0–2·5V and −10 to +10dB relative to 1mW into 600 ohms. Price is £36.

Amos Stereo Meter

Model 158 by Amos of Exeter comprises two of their 156 audio output meters housed in a single cabinet. Power range (10mW, 100mW, 1W, 10W f.s.d.) and impedance selection switches are ganged. The meters are also calibrated in dB. The two channels are matched to 2 per cent. Price is £34 10s.

TRADE TOPICS *Letters to the Editor*

The Editor welcomes letters on subjects of technical or trade interest, but does not necessarily endorse the views or opinions expressed by correspondents.

Switchable Sets

YOUR contributor G. L. A. Morgan (*Letters, August*) touches a chord of response when he suggests a campaign against the two-standard TV set. But I fear he is fighting a lost cause.

Although some of the experts have condemned "switchable sets" as unworkable, it seems likely that when the new standards set out in the TAC Report are finally agreed upon, we in the trade will be faced with another bunch of problem receivers.

Almost certainly, some manufacturers will bring out television sets designed (if that's the word) to get the best of both worlds. However "unworkable" the dual-standard receiver is reckoned to be you can bet that it will burst upon the market with the usual flourish of trumpets. *Then* look out, dealers and servicemen!—**P. A. Milner,** *Birmingham.*

Threat to Sales?

MAY I add my piece to the correspondence revolving round the TAC Report? A factor that seems to have been overlooked amid all the ballyhoo is the threat to sales. Many people, reading arrant nonsense in the lay press, imagine that the new standards are just around the corner. They imagine, too, that their sets will become out of date quite soon.

I have already had three enquiries from old customers who have previously been tempted to buy new sets at periods varying from two to five years. Each voiced the same doubt: "Wouldn't it be better to wait—or to rent a set—till the new ones are on the market?"

Reassurance by us is often misconstrued as "sales talk". What it really wants is a high-powered press campaign to present the real facts to the man in the street. I suggest that a few dealers could make a start by writing to their local papers.—**S. Saxon,** *Bristol.*

Another Boycott?

I WONDER how many other service engineers have the same problems as me with foreign sets. The transistor portable is becoming more and more popular and the price and styling of the foreign ones has been acceptable to the public. But as for reliability—that's a different matter entirely.

I've had a number of these on the bench that seem to be designed never to be taken to bits. They use unidentifiable parts. They have transistors which are apparantly unique, and unobtainable. When you tackle them, the distributors blandly shrug their shoulders and say the spares will follow—some day. They have sold the little horrors and couldn't care less. They're all right, Jack.

If we all refused to service the foreign sets it might hit the importers where it hurts and make them cover sales with an adequate supply of spare parts.—**John B. James,** *London.*

TECHNICAL GEN for SERVICING MEN

RADIO, TELEVISION and AUDIO FAULT FINDING

PRESENTING DETAILS OF FAULTS ENCOUNTERED, DIAGNOSED AND CURED BY SERVICE ENGINEERS ON RADIO, TELEVISION AND AUDIO EQUIPMENT, TOGETHER WITH HINTS AND TIPS OF USE TO OTHER SERVICEMEN IN DEALING WITH DAY-TO-DAY SERVICE WORK.

Ultra V815

Line Stage Fault This receiver came in with poor width. The line output valve was not suspected as there was no customary cramping on the right normally experienced with a low emission valve. However, it was changed but with no improvement, as expected.

The h.t. was checked next and found to be low. The rectifier, reservoir capacitor and surge limiters were all checked and found to be in order. The a.c. input to the rectifier was likewise up to standard.

A test revealed that the h.t. current was much too high. Isolating the various h.t. circuits (there was no low leakage reading on the h.t. line when cold) showed the trouble was back in the line output stage. The 20P4 line output valve was drawing excessive h.t. current.

This was found to be due to insufficient drive on the grid, which in turn was traced to a low emission 20L1 line oscillator valve. This was a rather obvious cause for this fault but its effect was manifest in a rather roundabout way!—V.D.C., Bristol (797).

Elizabethan "Princess"

Tape Recorder Fault This tape recorder would not record. Valves and microphone were checked and found to be satisfactory. Voltages and currents were also found to be normal so it was decided to bring the 'scope out of retirement to help in the investigation.

The erase oscillator was O.K., as was the amplifier, and connecting the 'scope to the record head showed that the oscillator and modulation waveforms were normal. But still the machine would not record. Head cleanliness and pressures were then checked and found O.K. so as a last resort and against all recommendations the record head resistance was checked—and found normal.

The only thing left to try was a new record head and sure enough it cleared the fault. Checking the original head against the new one made me no wiser, because all readings were identical. A number of these tape recorders have been serviced recently, all with the same complaint, and all for the same reason.—J.A.B., Malton (809).

Bush TUG34A

Lack of Highlights The picture on this receiver was flat with no highlights, but otherwise was satisfactory. At first it looked as though the tube was falling off in emission, but plenty of brilliance was obtainable when the brilliance control was advanced.

The action of the interference limiter was checked and it was found that as soon as the spotter control was begun to be turned the picture was clipped even worse, there was no portion of the track where clipping did not take place.

This indicated that the limiter was operating even with the control in the fully off position. Voltages on the limiter were checked, and it was found that it was not biased off in any position of the spotter. This was due to a low anode voltage on the video output valve to which it is directly coupled, the reading being about 35 volts.

The operating conditions here were examined and the cathode bias was found to be too low causing excess anode current. Cathode by-pass capacitor was suspected but proved to be O.K. as did the cathode resistor (C29 and R23). A 9kΩ bleeder resistor is connected from the cathode to the h.t. rail to stabilise the bias. This was open circuit. A replacement effected a cure and brought back the highlights. The strange thing is that the sync and frequency response seemed unimpaired by the abnormal video output conditions.—V.D.C., Bristol (798).

Pye V310F/Pam 600F

Erratic Line Hold The trouble was unreliable line hold. At first it was thought to be due to the flywheel sync circuit but routine testing revealed no clues. Careful checking in the line oscillator stage was equally fruitless. It was noticed however, that the line hold control didn't appear to work in the same way as that of a new serviceable receiver.

With the line hold fully anticlockwise (and the timebases not locked) the control was turned, but after locking the picture normally the picture did not slide gently out of sync beyond this point but began tearing and finally broke up. This was very similar to the action obtained on a set without flywheel sync.

Also, when the picture was locked, the top inch or so of the picture had an S-shaped bend, a defect which went unnoticed on a normal programme but which showed up on the test card. It was a study of these symptoms that provided the clue.

It seemed that the line oscillator was being pulled off frequency and some of the flywheel action was being lost. This led us to suspect the adjustment of the stabilising coil in the anode circuit of the oscillator stage, but on trying to check this we found it was well and truly stuck and required some force to move it. When we did move it we were delighted to find that it was about four turns out of adjustment and the set worked perfectly.

We were not satisfied with this, however, for why should the coil be out of alignment when the core took so much moving? We soon found out why. The coil is mounted (with the printed circuit panel) on its side, and both coil and

(Continued on page 69)

Items for publication

in this feature are welcome, particulary in regard to the more unusual type of faults. All contributions used will be paid for at our usual rates.

When sending in items for Technical Gen, please write (or type) on one side of paper only, adding rough sketches (where considered necessary) on a separate sheet of paper. Correspondence should be addressed to — RR Service Engineer, 46 Chancery Lane, London, W.C.2.

The Editor does not necessarily endorse the views expressed by contributors to this feature

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  Square Wave, 800 μV to 80 V, peak-to-peak.
- Distortion less than 1% at 1,000 c/s.

Nett Price in U.K. **£30**

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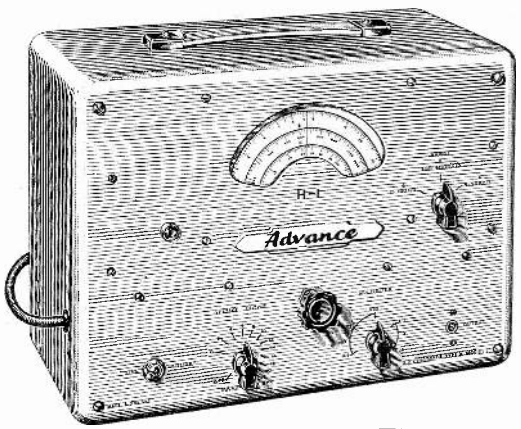

TYPE HI

Type J1

- Frequency range 15 c/s to 50,000 c/s.
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  Into 600 ohms, 0·1 mW to 1 W continuously variable.
  Into 5 ohms, maximum 0·5 W.
- Output Impedance.
  600 ohms, unbalanced.
  5 ohms, unbalanced (one side earthed).
- Distortion less than 2% at full output.

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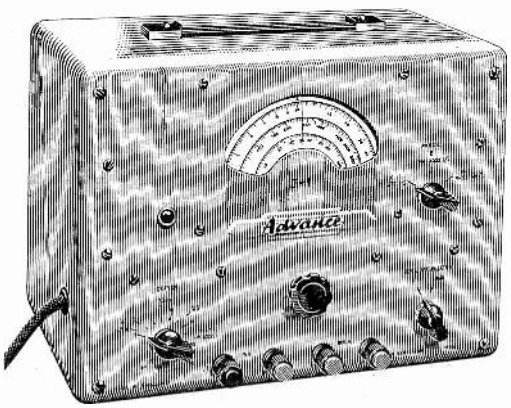

TYPE JI

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Identical with Type J1 but with output voltage meter.

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former are impregnated with wax. It was found that due to heat, the coil had moved towards the end of its former – nearly ¼ in. from the correct position.

It was easy to push the coil back on its former to the correct position and we wedged it there with a small piece of insulating material. It was then realigned and the set worked normally.—C.S., Bicester (789).

H.M.V. 1890

An A.G.C. Fault

A new receiver was unpacked and put on test. It functioned normally for some twenty minutes, then suddenly the picture went over-contrasty and sync appeared very critical. The contrast control was found to have no effect of any kind.

It was obvious that the a.g.c. line was not functioning correctly; the critical sync was, after all, quite usual when valves in the vision strip overload. Using a high resistance voltmeter, the a.g.c. line was tested on signal and negative volts were well below the expected value and removing the aerial made little difference.

After chasing several red herrings, the sync clue was taken and indeed was the answer. The 0·1μF coupling capacitor from the vision output to the sync valve input proved the culprit. It had become o/c. The negative voltage appearing on the sync valve grid, due to the diode action, is used to provide the negative potential for the a.g.c. voltage after suitable smoothing. The contrast control provides a backing-off voltage from the h.t. line via the control itself. Replacement of the offending capacitor restored normal operation.—A.B.C., Billericay (803).

RECEIVER SPOT CHECKS

No. 59: BUSH TV83, TV85, T85C

Low Gain: Check R201 for h.r. or C204 feed-through capacitor for leakage.

No Sound or Vision: Check R206 for o/c and C289 for s/c, R207 for o/c and C212 for s/c, R212 for o/c and C220 for s/c, C219 for leakage and R211 o/c, R218 o/c and C224 s/c.

Frame Timebase Inoperative: Check C108 for s/c, C107, C109 and C113 for fault and T102 primary for o/c.

Cramping at Top: Check C115 for leakage.

Cramping at Bottom: Check C113 for leakage, C117 for low capacitance or o/c.

Line Timebase Inoperative: Check C122 for o/c or s/c causing lack of boost voltage, TC101 leaky or C121 leaky, R132 o/c and C133 s/c, C120 o/c or C123 s/c, L105, L106, L107 or L108 o/c, faulty T103.

No Sync: Check primary for o/c. If no frame sync, check for faulty CD101 or o/c C104. If no line sync, check for faulty MR101, C102, C103, and for s/c C101, C132.—E.L., Long Eaton (777B).

Marconiphone T82B

Very Low Gain

This was a stock transistor radio and gain was very low, although at the instant of switching on the output was quite high. The a.f. and output stages were up to standard and voltages in the i.f. stages appeared to be fairly normal—fractions of a volt take a bit of getting used to!

A diode across the primary of the 2nd i.f. transformer is used in this set to improve the a.g.c. action, damping the transformer when in a conducting state, and disconnecting this diode brought gain up to normal. But a replacement diode brought back the original conditions.

Critical voltage checking showed that the emitter voltage on TR3 was slightly higher than that on TR2, which meant that the diode was in a conducting condition at all times. TR3 was apparently normal, apart from passing slightly more current than usual, and a replacement cured the trouble.—C.A.F., Clydebank (805).

Ferguson 536T

Line Fold Over

A 6 in. wide raster with fold-over at both sides was the sight that greeted us on this set. Only a "false lock" could be obtained with the line hold. The line blocking oscillator circuit was checked, but while voltages were being measured, the fault cleared and refused to come on again.

As the effect was rather an unusual one, it was decided to try to simulate it by open circuiting appropriate capacitors and resistors and shunting capacitors with resistors to give the effect of leaks. Several similar but not identical effects could be obtained in this way.

Eventually the ·01μF coupling capacitor to the output valve was bridged with a high value resistor and exactly the same symptoms observed. The capacitor was changed and no further trouble has been reported.—V.D.C., Bristol (799).

Brainless Bertie

"Hum on a radio? What a cop!"
Cried Bertie. Stand by for jolts . . .
Smoothers and customer blew their top,
He forgot to check "Wkg. Volts."

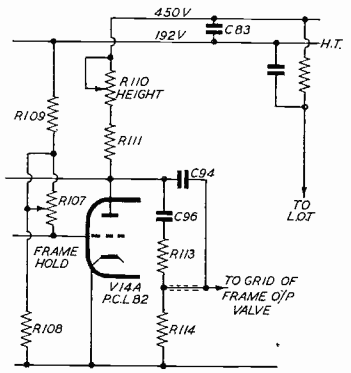
Feste

Philips 1796U

Raster Too Short

This one came in for service with a raster which, when at full height, still left blank two inches at the top and bottom of the screen. Valve substitution proved fruitless but on taking voltages it was found that the anode voltage of V14A (part of the frame multivibrator) was rather low.

Examination of the circuit diagram will show that the voltage to this anode is taken from the line output transformer and is supplied via two resistors, one being the height control. This additional h.t. rail also feeds the first anode of the c.r.t. and should be about 450V.



In this case the voltage was well below 400V and on checking C83, a 0·027μF capacitor between this rail and h.t., it was found to be reading 100kΩ. Replacement restored the voltage to 450V and this gave correct control of height.—D.McL., Lochgilphead (783).

Pye 310F

Very Narrow Raster

This fault, which could also apply to the Invicta 738/0 and Pam 600F, took the form of a raster only 1½ in. wide, linked like a metal watch strap. Then after a minute, the screen went blank and the PY81 anode glowed red.

Suspecting a short on the boost h.t. line or scan coils ohmmeter tests were made but there was no leakage. The

(Continued on page 71)

TECHNICAL GEN continued

scan coils were replaced but the fault remained, and substituting the PCF80 line oscillator, PL81 line output, PY81 and EY86 did not improve matters. Not having a replacement line output transformer, components associated with it were substituted—L16 injection choke, C89 (0·001μF), C91 (0·1μF) and C93 (0·1μF)—again with no change.

On replacing C90, the 210pF efficiency diode cathode capacitor, the raster remained at 1½ in., wide but this time it stayed on and stopped the PY81 anode glowing red. It was found then that the short raster was caused by the 0·15μF capacitor C94 in series with the scan coils which was o/c. Did one component cause the other to break down, thus causing these two faults? Possibly C94 went o/c, thus causing an overload on the line output stage, causing C90 to go s/c after a minute of switching on.—S.W., Buckingham (802).

SERVICE BRIEFS

H.M.V. 1892: Symptoms: very faint modulation on raster, usually intermittent, and starts when set is hot. Look for wafer type choke on top of chassis, centrally placed near video amplifier. This choke has fine wire tags and the choke wires have a tendency to become o/c between tag and winding.—W.S., Warminster (653).

Ferranti T1002/1: Hissing sound, very "snowy" vision, with good signal input would appear to be a weak 30L1, but in fact this turns out to be the 0·001μF turret coupling capacitor to the EF85 leaking and putting positive bias on this valve.—W.S., Warminster (654).

Murphy V240C: After an hour the left hand half of the screen went black, the other half remaining normal. The line output and boost stages were checked without result. The c.r.t and its first anode decoupling was also normal. Before delving into awkwardly placed line circuit components it was decided to check the main smoothing capacitor (200μF). It was o/c and a replacement cured the trouble, although h.t. increased by only 10V and there had been no hum on sound.—G.H., Harrogate (664).

Telefunken 75: Trouble on this tape recorder was distorted playback, no erasing or recording. We had fun finding the fault, having no service sheet. By side-to-side comparison with a new model, it was found that on Record there was a hefty r.f. arc from the oscillator bias coil if the tags were touched with a screwdriver. This arc was absent on the faulty model, although voltages were normal. The trouble was the 910pF capacitor from the oscillator coil tapping to chassis; it was s/c.—G.C., Boroughbridge (680).

Grundig TK20: We have had a number of these tape recorders with the same fault which in every case has been caused by the 1·2M V1 screen resistor R22 going o/c. Symptoms are weak and distorted recording and playback. R22 is a very tiny component and we always replace with a ½-watt high stability type.—G.C., Boroughbridge (679).

G.E.C. BC501

Loud Noise Develops

Noise developing some time after switching on is quite common in mains and even battery-operated valve receivers, but rather unusual in a transistor receiver where the usual cause (heat) is the last thing to be expected.

After about half an hour, a continuous crackling almost blotted out reception on this receiver, but all voltages remained constant except the signal diode output and those of the transistor controlled by a.g.c. This pointed to a bad contact somewhere in the i.f. or r.f. stages but all the coils carrying current tested normally.

In the end it was found that the oscillator coil L6, carrying no d.c. at all, had an unsoldered lead inside the can. The reason why the crackling always took about half an hour to develop still mystifies me.—C.A.F., Clydebank (804).

Alba T655

Hoots on Sound

The complaint with this receiver was the picture was all right but a loud hooting noise was on the sound. The PCL83 combined a.f. amplifier and sound output was suspected from past experience with this type and changed, but with still the same results. It was then noticed that the volume control did not affect the volume of the noise but altered the pitch of the note.

Examination of the circuit revealed that the two sections of the PCL83 were resistance-capacitance coupled in the conventional way, but there was a common cathode resistor of 120 ohms. This was by-passed by a 100μF capacitor. It was obvious that if the capacitor was removed, the circuit would be that of a cathode coupled multivibrator.

The volume control being in the grid circuit would act as a frequency control. The theory was tested by changing the bypass capacitor (C33). The sound was thereupon restored to normal. This effect was somewhat unexpected as a result of an o/c cathode capacitor, as with the normal separate bias resistors, the usual effect is lack of volume due to negative feedback over the cathode resistor.—V.D.C., Bristol (796).

Invicta 5370

Very Small Raster

The trouble with this set (which could also apply to Pye 310S and Pam 600S series) was lack of width and height giving a 5×3 in. raster. With aerial connected to the set the line hold control could not be made to lock this small picture, indicating a fault in the line oscillator circuit.

The anode voltage on the PCF80 triode section was high and a component check revealed that the anode load resistor on the time base panel (R90) was only reading 1kΩ instead of the normal 47kΩ. The resistor was replaced and the set switched on but the fault persisted. On switching off and again measuring R90 it still read 1kΩ.

The trouble was then traced to the 270pF capacitor C76 which is in parallel with R90. It had a leakage of 1kΩ.—S.W., Buckingham (782).

● odd spot

Answering an anxious call from a customer describing hum on sound with dark bottom half of raster we found on arrival an apologetic housewife explaining that it was O.K. now, sorry to have bothered us, but we could check it if we wished.

The performance was perfect during visit, and the textbook description of a H/K valve leak given by her over the phone with her panic-like insistence for immediate service showed that some solid fault had occurred. Examination in the rear of the set to adjust the centring showed traces of water on the bottom of the cabinet and odd drops on the linoleum under the set. In the hearth was a vase of flowers that normally stood on the top of the set.

If a vase of flowers tipped over while on this model the water would tip down the many knob slots causing a varied mixture of fault symptoms as it dripped through the circuit to the bottom. But when switched on the accumulated heat would dry it out with normal results later. When challenged she refused to admit this, despite the residue on the set bottom. She was also confident it would be all right now—and it has been!—L.E.H., Edgware (812).

GOOD NEWS FOR SERVICE ENGINEERS

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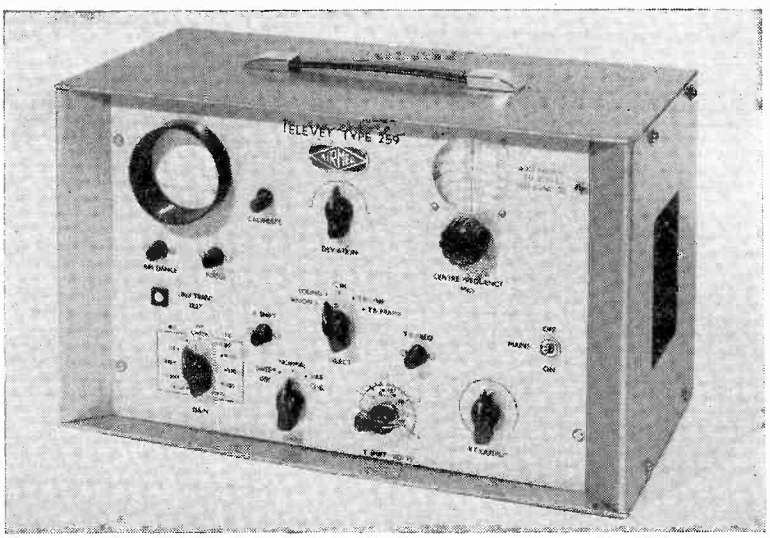

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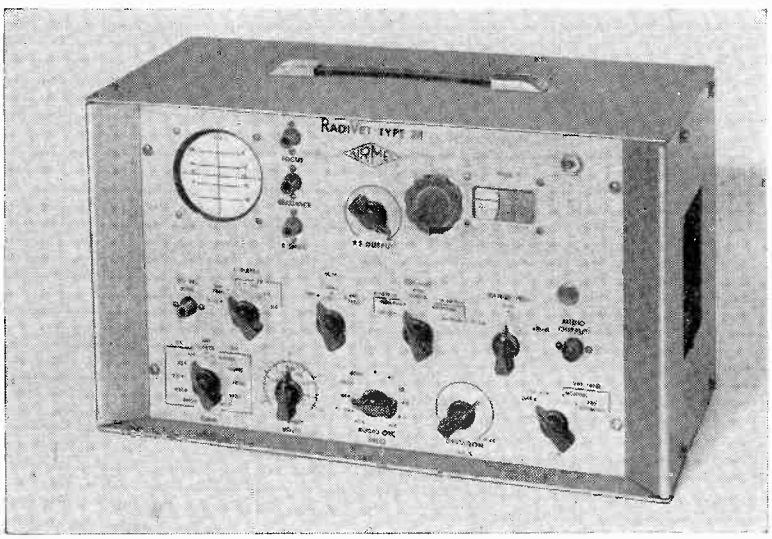

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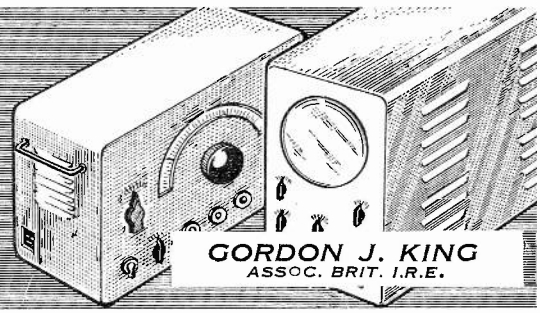


GORDON J. KING
ASSOC. BRIT. I.R.E.

IN addition to the signal generator, which was dealt with last month, life is made much easier for the practicing service technician if he has available, for immediate action, a generator for producing a locked pattern on the screen of a television receiver.

With such a device of known signal characteristics and level an after-service television receiver can be made ready for delivery to its owner without the aid of a BBC or ITA transmission. Height, width, linearity, picture shift, focus and other adjustments are thus facilitated, and once one is really conversant with such an instrument, a receiver so set up in the workshop will be a sure bet for working on the customer's aerial with only the smallest of final adjustment. This can save time and relieve more skilled staff for the jobs better suited to their qualifications.

A pattern generator is really a small TV transmitter, the carrier of which is modulated with various pulses to simulate the modulation and sync pulses of a real transmission. Pattern generators usually tune over the TV bands, and thus give a sound signal when required. Most have some form of signal level control and a selection of patterns which can be chosen by the operation of a switch.

Working outside TV hours, the field service engineer can get through many more jobs by carrying his own signal with him. In the workshop, in addition to setting-up receivers, the instrument can be used for fault tracing. Some instruments have terminals delivering the video signal only.

This means that investigation of the video amplifier and sync circuits of a faulty receiver is considerably eased, especially if an oscilloscope is also available. The video output from such an instrument is synonymous to the audio signal obtained from most signal generators.

PART FOUR
Wobbulators, Pattern and Audio Generators

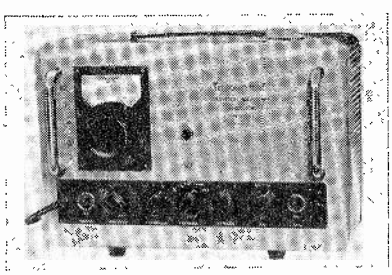
Wobbulators

A wobbulator is another very useful instrument. This is really a signal generator, tuneable over the f.m. and TV bands, which is frequency modulated either by 50 c/s mains or by the "X" timebase of an oscilloscope, for the purpose of giving a visual display of the test receiver's tuned circuit responses on the screen of a C.R.T.

The "Y" amplifier of the 'scope is connected across the test receiver's detector load to give a vertical deflection of response over the band of frequencies at which the wobbulator is swept by the "X" timebase. Since the 'scope's spot is also deflected horizontally by the timebase, a response pattern is built up on the screen.

More and more service technicians are finding that this method of receiver alignment is not only far quicker than the old spot frequency method, but that it is also far more accurate, and that a receiver so tuned has a far better definition than if tuned by signal generator and output meter.

To give some idea of frequency points over the displayed curve, a signal generator can be used in conjunction with a wobbulator to provide a frequency pip, where required, along the trace. Some wobbulators feature a built-in marker generator for this purpose.



The Telequipment WG/44 provides a complete sound and vision signal with sync waveform.

A.F. Generators

The a.f. signal generator is coming more into its own now that hi-fi servicing is being practiced extensively in workshops throughout the country. A good a.f. generator is essential for this work; for checking amplifier frequency response, loudspeaker resonances and loading, distortion, phase shift and so on.

An instrument of this kind is essential for tracing faults in tape recorders. It can also be used for checking wow and flutter, in conjunction with a 'scope and test tape. It also has its applications in ordinary TV and radio service work.

It is now time to look at a few of these various instruments, which have been designed over the last year or two, specifically for the service engineer; to enable him to keep in tip-top form the millions of domestic electronic devices which he has pledged to maintain. Let us start with pattern generators.

Telequipment WG/44

The WG/44 provides a complete sound and vision signal, with a fully synchronised waveform, on which the engineer can adjust any receiver. The sync waveform is strictly in accordance with the BBC and ITA standards, and the tests patterns will perform all the functions for which Test Card "C" is normally required.

The generator operates over 40–70 Mc/s and 170–220 Mc/s, and a continuously variable attenuator provides from 10μV to 10mV. There is a choice of five patterns with or without definition bars of 1·5, 2, 2·5 and 3 Mc/s, in addition to a plain black or white synchronised raster.

For operation on 200–250V 50 c/s mains, the instrument is compact and portable. It measures $11\frac{1}{2} \times 8 \times 5\frac{1}{2}$ in. and weighs 15 lbs.

Taylor Model 94A

Here six instruments are contained in one case. The 94A contains: still pattern transmitter for 405, 525 or 625 definition TV systems (the latter two coming under Model 94B), providing various test patterns with blanking, interlacing and equalising signals

together with variable definition bars from 1·5 to 4·5 Mc/s—a continuously variable c.w. generator with provision for external modulation; a.m. signal generator with variable depth control; f.m. signal generator with continuously variable deviation control; sweep alignment generator; fixed frequency audio generator.

The r.f. level of the pattern generator is 50mV maximum, with a switched −20dB and −40dB attenuator. The output impendance is 75 ohms, unbalanced, and the frequency coverage is from 4 to 220 Mc/s in six ranges, with a calibration accuracy of ±1 per cent. The modulation waveform is switchable to provide a black raster, a white raster and intermediate horizontal and/or vertical patterns, with or without vertical definition bars.

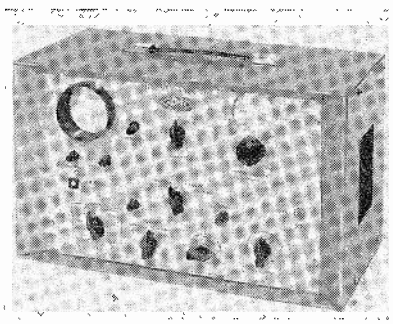
This sync waveform exactly matches that of a transmitter. The video waveform, either positive or negative, is available when required, as also is the composite sync signal.

The c.w. and a.m. generator has a like frequency range and 30mV maximum output level. Modulation with the 405-line instrument is at 750 c/s, and the modulation depth can be varied up to approximately 70 per cent. Audio only is available from 0 to 3V.

The f.m. signal generator has a range of 5 to 220 Mc/s with a calibration accuracy of ±3 per cent and a maximum output of 3mV, switched at −20 and −40dB. The sweep frequency is approximately 900 c/s and the deviation continuously variable to 200 kc/s maximum. On sweep, the instrument has like range and output. The sweep frequency is 50–60 c/s, bandwidth continuously variable to 7 Mc/s and a controllable sweep length.

Airmec Model 259 (Televet)

This is another composite instrument, providing not only a pattern generator, but also wobbulator, a.m. signal generator, l.f. oscillator, e.h.t. voltmeter, line transformer test and a.c. and d.c. voltmeter. The frequency range of the instrument covers the i.f. band and TV bands I and III in two ranges: 8 to 70 Mc/s and 169 to 230 Mc/s.



A composite instrument, the *Televet* provides seven separate facilities for alignment and test.

A spiral tuning dial, which has a scale length of four feet, is calibrated directly in frequency, with calibrations at every 100 kc/s. A 5 Mc/s crystal is incorporated which gives audio beat notes at all multiple frequencies of 5 Mc/s for scale setting.

A pattern consisting of either three horizontal or three vertical black lines on a white background is produced by an internally generated modulation signal containing either line or frame sync pulses. The r.f. may also be amplitude modulated with a 5 kc/s pulse waveform. This audio signal is available via an l.f. probe at 2V peak-to-peak.

Frequency modulation is provided at 50 c/s with a sweep variable between 4 and 12 Mc/s. Maximum r.f. output is approximately 50mV, but this can be reduced via three steps of −20dB and a variable level control giving steps of 2dB attenuation.

A.c. and d.c. volts are measured on the 2¾ in. display tube in conjunction with calibrated "Y" amplifier and shift controls. A timebase provides "X" deflection over two ranges suitable for viewing line and frame timebase and sync waveforms. The c.r.t. is also used for visual alignment in conjunction with the wobbulator. In this application, marker pips generated by the 5 Mc/s crystal may be made to appear on the trace.

Further information on this instrument can be obtained from Test Report in March, 1960 issue of *Service Engineer*.

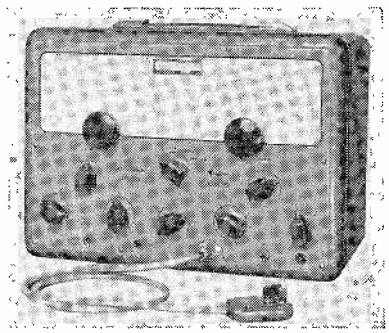
Taylor Model 61A

We turn now from pattern generators to wobbulators, but like pattern generators, which may represent only one feature of a composite instrument, some wobbulators are also just one part of a composite instrument. This is true of the Taylor 61A, which is an a.m./f.m. signal generator with sweep and crystal calibrator.

The sweep and f.m. generator covers from 4 to 120 Mc/s in three ranges. On "sweep" the bandwidth is variable up to 1 Mc/s at 50 c/s, and is thus suitable for visual alignment of the r.f., i.f. and discriminator or ratio detector stages of a.m. and f.m. receivers. However, the bandwidth is insufficient for the visual alignment of TV vision channels. A variable phasing network is incorporated and retrace blanking is also provided.

On f.m., the deviation is variable up to 100 kc/s at 400 c/s, while on a.m. the modulation depth is approximately 35 per cent also at 400 c/s. On both a.m. and f.m. the r.f. output is monitored by a crystal diode voltmeter, and is 100mV maximum, unbalanced to ground. Five steps of 20dB attenuation and a fine attenuator 0–20dB allow control of signal level. On "sweep", the output level is pre-set at 100mV ±30 per cent and is not monitored.

Modulation can be switched off



The Taylor 61A wobbulator provides sweep and f.m. signals from 4-120 Mc/s in three ranges.

giving c.w. only, and the 400 c/s modulation signal is available, via a level control, for audio tests. A crystal calibrator circuit, which can also be used to provide a marker for visual alignment, is provided with switch selection of any one of three internally mounted crystals. Crystals in the frequency range 1–11 Mc/s are available at extra charge.

The instrument is mains operated 105–125V and 200–250V 40–60 c/s, has dimensions 13×9×8 in. and weighs approximately 21 lbs.

Cossor Model 1323A

This model has a sweep bandwidth from ±150 kc/s to ±7·5 Mc/s, and is thus suitable for the visual alignment of TV receivers as well as radio receivers. The carrier can be set at frequencies between 5 Mc/s and 225 Mc/s and can be fed into any convenient point between the input of the test receiver and the aerial. The r.f. output voltage can be adjusted from 25μV to 40mV by coarse and fine attenuators.

An internal marker generator, which has a fundamental range from 10 to 22 Mc/s and with harmonics up to 220 Mc/s, is used for producing frequency pips on the trace. This can be calibrated with a crystal oscillator at 2 Mc/s in conjunction with a tuning indicator on the front panel.

The instrument is mains powered 105–255V 40–100 c/s, measures 9× 15⅝×8¼ in. and weighs 18 lbs. Model 1322 is a similar instrument covering Bands I and III only, and Model 1321 is a Band III converter for extending the range of Model 1320.

Cossor Model 1324

This instrument, known as f.m. Receiver Alignment Generator, comprises a carrier frequency generator in the bands 7·5 to 27·5 Mc/s and 87·5 to 107·5 Mc/s modulated by the sawtooth voltage of the display oscilloscope to provide the frequency sweep. The sweep is suitable for f.m. bandwidths and is variable between 25 and 400 kc/s.

The instrument also provides f.m. at 1,000 c/s with a deviation set at 75 kc/s. The a.f. is available (sine wave) up to 8V peak-to-peak for audio tests. An r.f. output of 40mV at 80 ohms is given through a coarse and continuously variable fine attenuator calibrated arbitrarily. The minimum output is less than 5μV.

The instrument is mains powered 105–255V 50–100 c/s, measures 8× 10¼× 7¾ in. and weighs 11½ lbs.

Grundig Model 6016

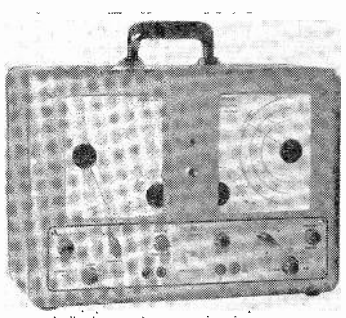
This is one of a new range of instruments by Grundig and marketed by Wolsey Electronics Limited. Model 6016 is a sweep frequency generator with a frequency range of 4 Mc/s to 250 Mc/s, continuously variable. The frequency is swept at the mains supply frequency and the deviation is from 1 Mc/s to 30 Mc/s in six ranges. The instrument is thus suitable for both f.m. and TV applications.

It features a separate tuneable oscillator which will provide a marker pip in the range of 4 Mc/s to 250 Mc/s. An additional marker, produced by a crystal oscillator of high accuracy, can be set up at intervals of 3·5 Mc/s. This can be used for calibrating the tuneable marker oscillator, and may also be used as a standard to give the correct spacing between TV sound and vision carriers.

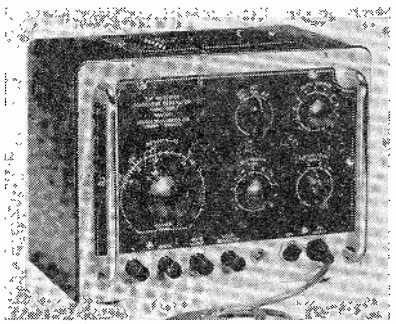
Provision is also available for modulating the marker oscillator from an internal 800 c/s source, or externally from any source frequency up to a maximum of 5·5 Mc/s.

The swept output signal is obtained from two separate oscillators, one fixed at approximately 250 Mc/s, which is frequency modulated by the sweep signal, and another which is tuneable over the range 250 Mc/s to 500 Mc/s. The two signals are mixed to produce the output signal.

The instrument provides from 0 to 100V r.m.s. for "X" deflection of the associated oscilloscope, and provision is made for suppression of the fixed oscillator during a half cycle of mains frequency, if required. The output voltage is approximately 50mV maximum at 60 ohms, variable by means



Model 6016, by Grundig, is a sweep frequency generator covering 4-250 Mc/s, deviation 1-30 Mc/s.



The Cossor 1324, a popular low-priced f.m. receiver alignment generator.

of a calibrated attenuator down to 10μV.

In a steel, silver grey case, the instrument measures 17×12×8¼ in. and weighs 33 lbs.

Advance Type J

This is an audio oscillator with a range of 15 to 50,000 c/s in three bands. This coverage is achieved by a bridge-type resistance capacitance oscillator feeding, via a buffer stage, into the output valve. The calibration accuracy is 2 per cent+1 c/s, and the distortion over the entire range is less than 2 per cent at full output above 100 c/s. The output is continuously variable from 0·1mW to 1 watt, and the output impendance is 600 ohms.

The J2 is identical in specification with the J1, but is provided with a first-grade 2 in. square flush mounted meter calibrated 0–40 volts a.c. as an output monitor.

The instrument is mains operated 105–125V and 200–250V, 40–100 c/s, measures 13½× 10¼× 8¼ in. deep and weighs 20 lbs.

Advance Type HI

This is a slightly less expensive audio oscillator than the J series, but has the same frequency range of 15 c/s to 50,000 c/s. The instrument provides a choice of sine or square wave output by switch selection. A tuning scale with a total length of 18 in., a larger section of which is always visible, gives an accuracy in the order of ±1 per cent.

Maximum sine wave output is 20 volts r.m.s. ±2dB and minimum 200 microvolts, via switched and continuously variable attenuator. The square wave output is variable between 800 microvolts and 80 volts peak-to-peak. Distortion is less than 1 per cent at 1 kc/s at a level of 20 volts, and the square wave rise time is less than 3 microseconds from 10 per cent to 90 per cent of peak value.

The instrument is mains operated 105–125V and 210–250V 40–100 c/s, measures 13½× 10¼× 8 in. deep and weighs 14 lbs.

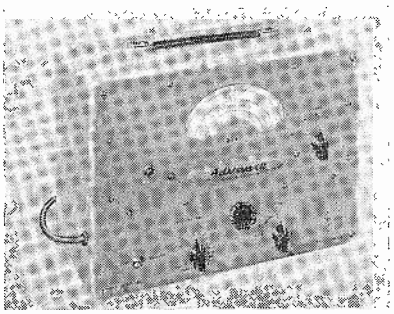
Furzehill Type G432

This instrument provides sine or square wave output, balanced or unbalanced, over a frequency range of 25 c/s to 250 kc/s. A subsidiary control provides a small incremental frequency variation independent of the main dial.

The instrument uses a modified Wien-bridge oscillator circuit, with variable-capacitor tuning. The output on either sine or square wave is 10mW into 600 ohms continuously variable and monitored by 2½ in. panel voltmeter. The output is maintained constant throughout the range by thermistor control of the bridge oscillator.

Square wave has a rise time of 0·1 microsecond and a sag less than 1 per cent. For precision setting of cardinal frequencies, beats may be obtained on a tuning indicator from a built-in tuning fork at multiples and sub-multiples of 1 and 10 kc/s with an accuracy of 0·01 per cent.

The instrument is for mains operation, 110–250V, 50–60 c/s, is available either for rack mounting or bench mounting, the approximate dimensions being 22× 14× 13½ in.



Sine or square wave output over the range 15 c/s to 50 kc/s is available from the Advance Model HI.

Grundig Model 295A

This beat-frequency oscillator uses two internal r.f. oscillators, one of which is tuneable, to provide audio frequencies over the range of 30 c/s to 20 kc/s. The difference frequency is fed, via a low-pass filter, to an amplifier with a cathode-follower output. The maximum output is 1V, and is continuously variable down to 0·1mV by means of a four-position decade switch and fine attenuator. There is provision for checking the output voltage by the use of an external meter.

An inbuilt amplifier can supply the audio at 8 watts across 3·5, 5, or 7 ohms and at 5 watts across 600 ohms, with a distortion less than 5 per cent. The signal/noise ratio, referred to maximum output, is better than 50dB, and the frequency response ±1dB.

The instrument also allows the determination of an unknown frequency

TEST INSTRUMENTS

—continued

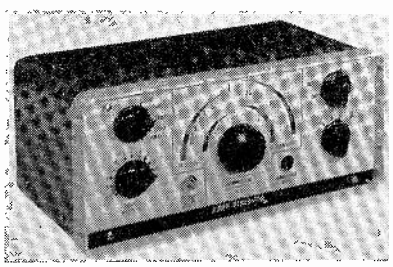
in the range of 30 c/s to 20 kc/s, and the inbuilt amplifier may be used alone to provide a low-distortion general purpose amplifier, with outputs as given above, with a response of 25 c/s to 30 kc/s ±1 per cent. A magic eye tuning indicator is fitted to facilitate obtaining zero-beat when making comparative frequency checks.

The instrument can be used on a.c. mains supplies of 200–240V, 40–60 c/s, and the consumption is 85 watts. Housed in a steel, silver grey case, measuring 8×11×5½ in., the instrument weighs approximately 22 lbs.

Jason Type AG10

This is available either built or in kit form. It features a capacity-tuned Wien-bridge giving excellent stability and low distortion. Four ranges cover from 10 c/s to 100 kc/s, and a maximum of 10 volts is available from the cathode-follower output stage. Either sine or square wave output is available, and this can be reduced in level in stages to a minimum of 1mV into 600 ohms.

The mark/space ratio of the square wave can be pre-adjusted from the front



The Jason AG10, a sine-square wave generator with provision for preadjusting mark/space ratio.

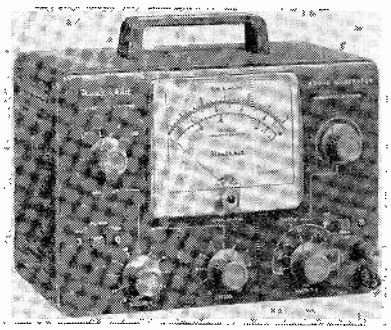
panel, and the rise time is better than 2 microseconds at all frequencies. The instrument is mains operated, and has dimensions 11½×5¼×6½ in. deep.

Beulah Model AG–9U–F

This is one of a recently introduced range of instruments, marketed by Direct TV Replacements Limited, which are basically constructed from the Heathkit range, only available in this country in kit form. This audio generator has been designed for hi-fi, general audio, ultrasonic and i.f. applications demanding a pure sine wave.

The frequency range is from 10 c/s to 100 kc/s, and the distortion between 20 c/s and 20 kc/s is less than 0·1 per cent. A bridged-T network provides the signal. Attenuation is effected by a decade step attenuator in conjunction with a continuously variable fine attenuator.

The output level is maintained at ±1dB over the entire range of frequency



Appearance of the Beulah AG-9U-F (assembled) and the Heathkit AG-9U kit) sine wave a.f. generator covering from 20 c/s to 20 kc/s.

and the output can be varied from 10V to 3mV, this being monitored on a 4½ in. panel-mounted meter.

Heathkit Model AG–9U

This is the original kit form instrument on which the Beulah AG-9U-F is based, and the specification is as already described for the assembled instrument.

As usual, Heathkit supply comprehensive instructions with the parts.

Pye A.F. Oscillator

This instrument uses a novel type of resistance-capacitance oscillator, followed by a buffer linear amplifier. The frequency coverage is from 20 c/s to 20 kc/s in three ranges, and the output is 20V maximum into external load of 600 ohms, balanced or unbalanced. The output is continuously variable and its value is indicated on a meter.

Hum level is not greater than 0·2 per cent of maximum output and the distortion not greater than 2 per cent at maximum output. The instrument is mains operated, 200–250V, 40–60 c/s, measures 15½×9½×8 in. and weighs 21 lbs.

PATTERN GENERATORS

Make and Model	Range	Part of composite instrument	List Price
Taylor 94A	4–220 Mc/s	yes	£75 0s. 0d.
Telequipment WG/44	40–70, 170–220 Mc/s	no	£62 (net trade)
Airmec Televet 259	8–70, 169–230 Mc/s	yes	£69 6s. 0d.

WOBBULATORS

Make and Model	Range	Sweep (max)	List Price
Taylor 61A	4–120 Mc/s[4]	1 Mc/s	£49 14s. 0d.
Cossor 1324	7·5–27·5, 87·5–107·5 Mc/s	400 kc/s	£18 0s. 0d.
Cossor 1323A	5–225 Mc/s[4]	±7·5 Mc/s	£72 0s. 0d.
Airmec Televet 259	8–70, 169–230 Mc/s[4]	12 Mc/s	£69 6s. 0d.
Grundig 6016	4–250 Mc/s	30 Mc/s	£145 (net trade)

AUDIO GENERATORS

Make and Model	Range	Waveform	List Price
Advance J1/2	15 c/s–50 kc/s	Sine	£36 0s. 0d.[1]
Advance H1	15 c/s–50 kc/s	Sine and Square	£30 0s. 0d.
Beulah AG9UF	20 c/s–20 kc/s	Sine	£26 3s. 0d.
Furzehill G432	25 c/s–250 kc/s	Sine and Square	£187 10s. 0d.[3]
Heathkit AG9U	20 c/s–20 kc/s	Sine	£19 3s. 0d.
Jason AG10	10 c/s–100 kc/s	Sine or Square	£17 10s. 0d.[2]
Pye	20 c/s–20 kc/s	Sine	£70 0s. 0d.
Grundig 295A	30 c/s–20 kc/s	Sine	£98 10s. 0d. (net trade)

[1] J2 with monitor meter, £42.
[2] In kit form £14 5s. 0d.
[3] Ex-works.
[4] Internal marker facilities provided.

SUMMARY TABLE OF INSTRUMENTS DESCRIBED IN THIS ARTICLE

Part Five

in this series of articles appears next month and will deal with oscilloscopes (the first of two articles). This will be followed by miscellaneous types of test instruments.

VALVE MICROPHONY — *Cause and Cure*

BY M. A. QUALES

Despite continuous improvements in valve design, the annoying fault of microphony is still encountered. Here are some notes on what causes the trouble and some practical hints on how to localize the fault.

DESPITE the great "transistor revolution", valves will be with us for some time to come. There are applications for which the thermionic valve is more suitable; operations in which it has no substitute; and situations where restrictions on power supply and space do not prevent equipment designers taking advantage of its comparative cheapness.

The service engineer, at any rate, will still meet plenty of valves—and their characteristic faults.

One of the most annoying of those valve faults is that of microphony. Not least because it can be intermittent and variable, and not always wholly due to the valve itself. *Recognition of its symptoms, causes and cures should be part of the serviceman's repertoire.*

The symptoms, at least, should be familiar. They take three main forms in domestic equipment. A gradual building up of a "howl" which sounds like audio feedback—and may, in fact be a form of this phenomenon. A "ringing" noise when vibration is applied to a chassis. And a distortion of a television picture that takes the form of intermittent bands across the screen, usually black, and sometimes accompanied by loss of sync.

Root Cause

Not always so apparent is the root cause of the microphony. It is generally recognised that vibration is to blame, but very often the source of mechanical stress is difficult to find.

And finding it is not enough, for the vibration may be inherent in the design of the equipment, as in the case of a compact chassis with the loudspeaker mounted within the confined space of the cabinet.

A great deal of intensive work has gone into making the thermionic valve more rugged and compact. Undoubtedly, many of the advances of the last decade or so are due to the increasing use of electronic equipment by Government establishments. Valves are put to use under conditions of fantastic rigour: they have to stand up to large and sudden mechanical stresses: they have to work to much closer tolerances than is usual in domestic receivers.

General Improvement

The result is development and research that eventually reaches us, in the radio retail trade, as a general improvement in valve design.

Extensive investigation was carried out, a few years ago, to find the requirements for reliability of a new range of "special quality valves". The valve manufacturers had been beset with complaints that valves had a shorter "life" than was desirable. Electronic equipment could be designed to finer limits and very often, said the designers, the weak link was the valve.

Counter-accusation

But the valve manufacturers came back with a counter-accusation. Valves were not being used within their correct ratings. Not enough allowance was being made for inevitable, though slight, deterioration. Neither was the factor of variable supply voltage and unregulated current always foreseen in equipment design.

The result was a two-fold improvement. First there came a drastic tightening of valve manufacturing techniques, with small but important alterations in basic design. Allied to this was the tendency to give much more detailed data, and exact tolerances.

Some of the features of the special quality valve have crept into general design, to our advantage. Of these features, most noticeable are:

(1) Doubling of the getter support assembly,
(2) Belling of the cathode ends,
(3) Provision of a shield mica beneath the getter,
(4) Doubling of the main mica plates,
(5) Increasing the contact points of mica to the interior of the glass envelope,
(6) Improved anode construction,
(7) Revolutionary changes in grid windings,
(8) Closer tolerances in glass envelope construction, and
(9) New methods of clipping electrodes and supports to the mica plates.

Added to this are improvements in material and manufacturing techniques, and much finer testing.

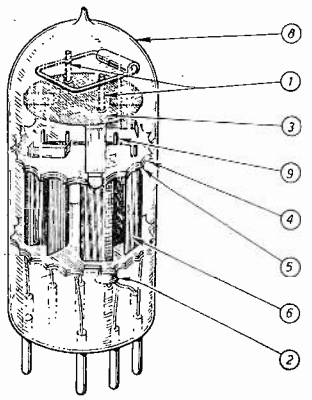


Fig. 1: Sketch of idealized modern valve showing some of the new design features described in the text.

Methods of Testing

Methods of testing for microphony are elaborate and often ingenious. The old days of hit-or-miss construction and comparison tests, based on theoretical measurements has gone. Nowadays, vibration tests can be made at varying frequencies (both of operation and mechanical movement), and stroboscopic arrangements enable the inspector to view individual electrodes and supports for unwanted resonances, while such structural weaknesses as faulty welds very soon show up.

One typical machine for vibration testing takes the form of a moving-coil type vibrator motor on which is mounted a vertical metal column supporting a bank of 24 miniature valves. The column is itself supported by a system of tensioned wires taken to three side pillars, and its acceleration during vibration is measured by a barium titanate crystal attached to the column head. The vibrator is fed from a suitable amplifier at a constant acceleration.

Fixed Frequencies

Tests are carried out at one or more fixed frequencies, selected as being most likely to cause resonance of the electrode system. A "search" test can be made with continuously variable frequency, also, the trouble spots showing as peak readings that can be further investigated.

A typical procedure would be fatigue tests at 50 c/s and 170 c/s at an accelera-

tion of 6g. with the valve held in two different horizontal and vertical planes. During this test the valve would be operating under typical conditions.

For example, the heater could be run at under or over voltage and switched off for periods of ten minutes each hour. Deterioration is then checked, vibration tests of from 25 to 2,500 c/s at a low g. taking place while microphonic output is recorded.

On the search gear, stroboscopic tests enable individual parts of the assembly to be checked for deterioration. As a further check, shock testing at up to 1,000 g. is carried out on sample valves. Other samples are tested to destruction. Yet others are run under constant conditions outside and within tolerance for life tests of reliability.

Life Tests

Life tests consist of overload vibratory fatigue tests for some 200 hours, and static running for 1,000 hours. A constant observation of operational curves is made during that period.

Finally, the valves used for test are destroyed, to prevent their inadvertently getting back into stock. The main run from which the sample was taken is held for a month or more, then retested for any deterioration of vacuum, before being released from bond.

This is only one typical procedure. Each manufacturer has his pet methods, but all are nowadays of a very high standard. Mass production has its advantages in closer manufacturing tolerances, more efficient machinery and rigorous testing.

Valve Structure

The structure of a thermionic valve is such that various parts of its assembly act as resonators at frequencies dependent upon their mass, stiffness and damping factor. Most electrodes and supports are longitudinal, tubular or filamentary, and in order to keep the amplitude of vibrations small it is advantageous to reduce the height of the electrode system as much as possible and to make the electrodes short and thick.

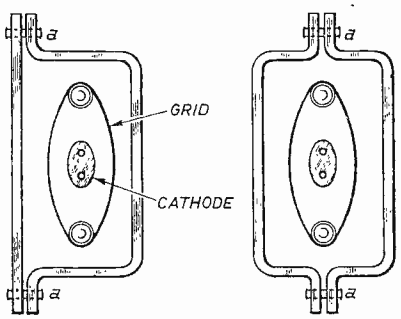


Fig. 2: Left – old style construction, vibration at anode fixing points a-a. Right – improved style, two halves lessen resonant peaks.

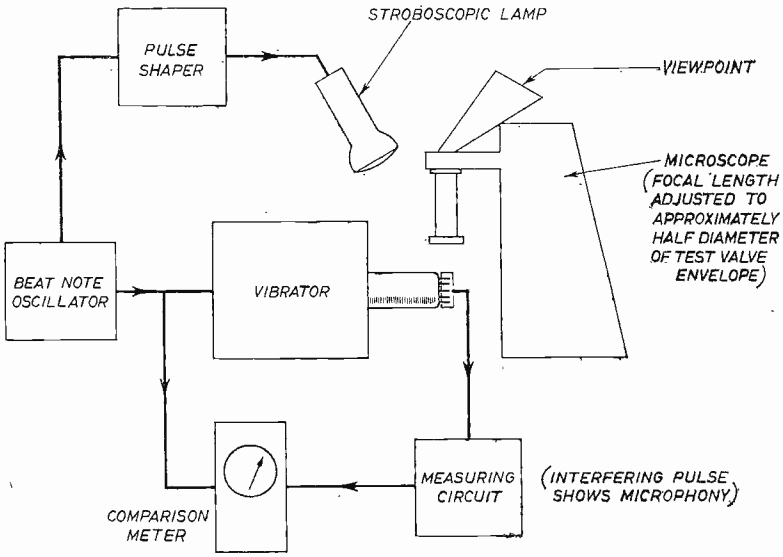


Fig. 3: Block diagram showing set-up for stroboscopic testing of microphonic sources.

Unfortunately, the parameters which determine operating conditions, particularly internal capacitances, may not require a structure that is best for the avoidance of microphony. In general, such devices as the double fixing of supports and electrodes, and the additional strengthening of grid systems by backbone supports, are considered normal practice nowadays, as well as the points mentioned above.

In practice the detection of microphony can be a tedious business. Vibration may be set up at a particular audio frequency, and be intermittent. Alternatively, the microphony may be present all the time that the set is amplifying sound.

Ringing

In the latter case, touching the chassis or any of the valves may bring on the characteristic "ringing". It may then be necessary to reduce the shock vibration by laboriously tapping with, for instance, a pencil around the end of which an elastic band has been wound. Failing this, it is often advantageous to reduce the heater current of suspected valves (by tapping up the mains selector or inserting additional resistance). *Microphony is then less prone—though still present, and is more easily localised.*

Further to this, hot valves are more liable to show weakness than cold ones. If the source of microphony cannot be traced immediately, switch off, let the set cool down, and begin tracing again from cold.

Where before a gentle tap was enough to set everything ringing, it should not be necessary to give quite a blow to the faulty valve, and to it alone, to inaugurate the feedback.

The case of the interfering signal that occurs at certain frequencies has to be tackled in a different way. Here it should be realised that the fault may not be in a valve at all. Quite often, the resonance is caused by vibration of structural parts having loosened. A typical suspect is the output transformer with loose laminations.

In the television receiver it is likely that the source may be quite separate from the sound stages; a frame transformer or scan coil assembly, for instance—both possible causes of a "buzz" that sometimes sounds like microphony.

Other Causes

Other possibilities will spring to mind: loose turns of a speech coil, loudspeaker mounting bolts, baffle screws escutcheon metalwork, even knobs that have cracked can cause these annoying intermittent noises. They can usually be localised by careful listening.

The microphonic valve is not so easy to pinpoint, because the interfering signal comes out of the loudspeaker, wherever its source. In one baffling case, the author found it necessary to stimulate the fault with an audio oscillator. The input was fed to the detector network—not directly to the first audio grid, for a fault could havt been masked by the damping effece of the probe. Then the oscillator was swept through its range at a fairly high output setting. The "howl" came into action at around 600 c/s.

The next step was to reduce the attenuator setting until the feedback stopped, then gradually increase it to the point of instability. *At that juncture it was possible to tap the suspected valves gently and the culprit showed unmistakeable signs of microphony.*

The above method may seem crude, but was certainly quicker than waiting

for the fault to appear, jumping to a conclusion, changing a possibly faulty valve, then waiting in vain for the fault to re-appear—without being certain that a cure had been effected.

Combined Valves

Frequent offenders, in my experience, are the combination output valves, such as ECL80 and PCL83, in many television receivers. But care should be taken when testing for output stage instability; the fault may be in the grid circuit. Some circuits use a variable feed to the grid, the volume control being the grid load, with possibly a stopper resistor in series.

A slightly noisy track will aggravate the fault condition, as will high resistance joints in this circuit. Replacing the valve appears to effect a cure, but as the new valve settles down, the symptoms may show up again.

It is perhaps unfortunate that set designers expect these valves to do a heavy job for ever. As a counter to the above fault, the symptoms of a dirty volume control, temporarily alleviated by cleaning or replacement, can be partly the effect of a failing output valve. It is sometimes an advantage to add an isolating network of blocking capacitor and new load resistor if the fault recurs.

Turret Valves

Microphonic turret valves in a television receiver are another fairly frequent fault. Once again, although replacement may seem to cure the fault, it pays to look a little deeper. A common culprit is the dropper resistor to the oscillator section, which goes "high", reducing the supply voltage (h.t.). Many sets use a 10kΩ or 6·8kΩ non-inductive resistor in this position.

Care should be taken that the wattage of the replacement is adequate. Overheating can cause other alarming symptoms, such as frequency drift due to damaged capacitors!

The frequency changer stages of battery portables are prone to this fault also. Symptoms of microphony crop up when the h.t. falls below a certain point. The valve itself may be losing emission slightly, may indeed be slightly microphonic, but the prime cause is the low feed voltage. Replacement of the battery cures the fault.

However, care should be taken that the point at which microphony appears is not too near the working limits of the battery—in which case the valve would have to be replaced anyway.

Tuning Capacitor

As a final practical note, microphony is sometimes caused by a sympathetic resonance. Possible root cause is a loose vane of a ganged tuning capacitor.

There have been occasions when the fault was almost impossible to cure, even by mounting the gang on rubbers and enclosing the valve in a padded screen. Replacement by a more robust gang or re-siting of the offending items was the only cure.

There was even one isolated example of a "midget" that howled on the high-frequency end of the medium wave band, and which was cured eventually by slight misalignment, bringing the 200 metre mark up slightly, so that the vanes were a little more in mesh for the reception of the required station.

Such subterfuges will be common in many workshops. But it seems a pity when the manufacturers of valves take such trouble to better their products.

The author wishes to thank the following for assistance and advice in the preparation of the foregoing article:
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SERVICE WITH A GRIN

by H. W. HELLYER

On not Visiting

I refuse to mention the Radio Show. You must be all sick and tired of reading about So-and-so's impressions and Whatsisname's criticisms, not to mention old Whosit and his inevitable comparison with the last show: "Earl's Court ain't wot it used ter be."

Of course it isn't. It never was. I doubt whether it ever will be, the theme being so rapidly progressive. Why, I can almost see the news item of nineteen-mumble-de-dum . . . "*An interesting exhibition of musical instruments at the new glass palace on the Bayswater Road. A novel feature being the inclusion of equipment used to propagate and reproduce the music.*"

By then, Joe, there will be no point in showing television sets. The screen in the corner will be a part of the architecture. If you don't like the tint of the tube you can always move, can't you?

So I'll try not to mention the Radio Show. The daily press has wrapped it up lovingly and served it for several breakfasts. We have seen the photos—I'm sure they pull the same one out year after year—of the vast assembly viewed from the topmost balcony rail. With the icecream cartons and cigarette packets tactfully blotted out, of course.

There is the picture of Lord Somebody smiling even more vaguely than usual at the presentable wife of a small director. He is quoted: "*Favourite programme? Sorry, old boy. Never watch it, what.*" He is, naturally, on the Government Committee for the Furtherance of High-Quality Broadcasting. Who isn't, what?

And the tabloids—they would never miss the blatant advertisement of the pretty model poised before a waterfall, holding a miniscule minor.

I made the mistake, one year, of approaching one of those charmers and asking her, "*Is it push-pull output?*" You've seen the look in a Sunday-School teacher's eyes when somebody whispers "Wolfenden"? Then you will know how I felt as I slunk around the stand to seek "authoritative opinions" elsewhere.

"Is it push-pull output?"

Which raises another point—the "reliable source", the informed critic, the special correspondent. Have you ever met him at you know where?

Our Special TV Correspondent is a rather cagey customer. He skulks around the Press receptions, his sharp nose cocked like an audiophile's ear, but he is seeking drinks not decibels. When the speeches come he dreamily perches before one of the monitor sets.

The doodles he is scribbling in the margin of the handout indicate that the great brain is cogitating tomorrow's column. *Lord Whosit said to me* . . . he will mention casually, forgetting to add

The Special TV Correspondent's tottering progress.

that Lord Whosit also addressed a couple of hundred other hearers.

And the combination of whisky fumes and last year's undigested claims lead to his tottering progress around the stands to seek, as I did, "Authoritative opinions". The difference is that he has the temerity to quote them. Which is why he will undoubtedly come up again this year, and next if "Guitar Corner" and "Movie-tone Alley" have not crowded the radio and TV out, with the plaint that the public is still being defrauded—they cannot buy those elusive D.C. Components over the counter.

Our Special Correspondent had it from a "reliable source" that a picture without a D.C. component was like potatoes without their salt, or a cocktail minus its cherry, to be more relevant. Too many cocktails or too few cherries and we will find the next day's column bemoaning British lack of technical achievement. We shall be told "the Yanks do it bigger, the Japs do it better, and the Russians do it more often."

Our Service Department has felt the pinch.

Sometimes, looking around that place I am not going to mention this month, especially in its labour pains of the hours before opening, I wonder that the British ever manage to do it at all!

If this sounds a little sour, there is a good reason. That fellow Amory's to blame. With the present position in the trade, the tightening of belts, the unremitting pressure on the pocket, the economic strictures that have penetrated even to the backwater where I do my daily stint, our service department has felt the pinch.

Already, that dread word "redundancy" has sounded its ugly echo. Those of us who are listed on the workshop records as part of the fixtures and fittings find ourselves running around with chicken-like alacrity. It is a curious phenomenon that as sales decline the pressure on service rises. Not in the number of fresh jobs, maybe; rather with the urgency with which each complaint is passed on by the "front-floor" staff.

Also the tendency for shop managers and proprietors to whittle down "frivolous" complaints, often means that by the time the serviceman reaches the customer's house some light-fingered salesman has made the trivial fault really worth-while in trying to cure it. This especially applies when maintenance complaints come in. "*Every job's a loss,*" growls the manager.

So it looks rather as if Joe and I are going to share the heat of the day till trade perks up. We can hardly hope to make the trip to London—even though my wife is hinting she would like a new piano! Any request that the firm should sponsor the trip or give us paid time off only evokes a bitter laugh.

So, if I can't go, I can't write about it, can I? After all, I don't possess the inventive genius of "Our Special Correspondent" from the daily press, who curls up in the corner of the Buttery Bar and sees it all. Under the circumstances it would not be ethical—Let's talk about something else . . .

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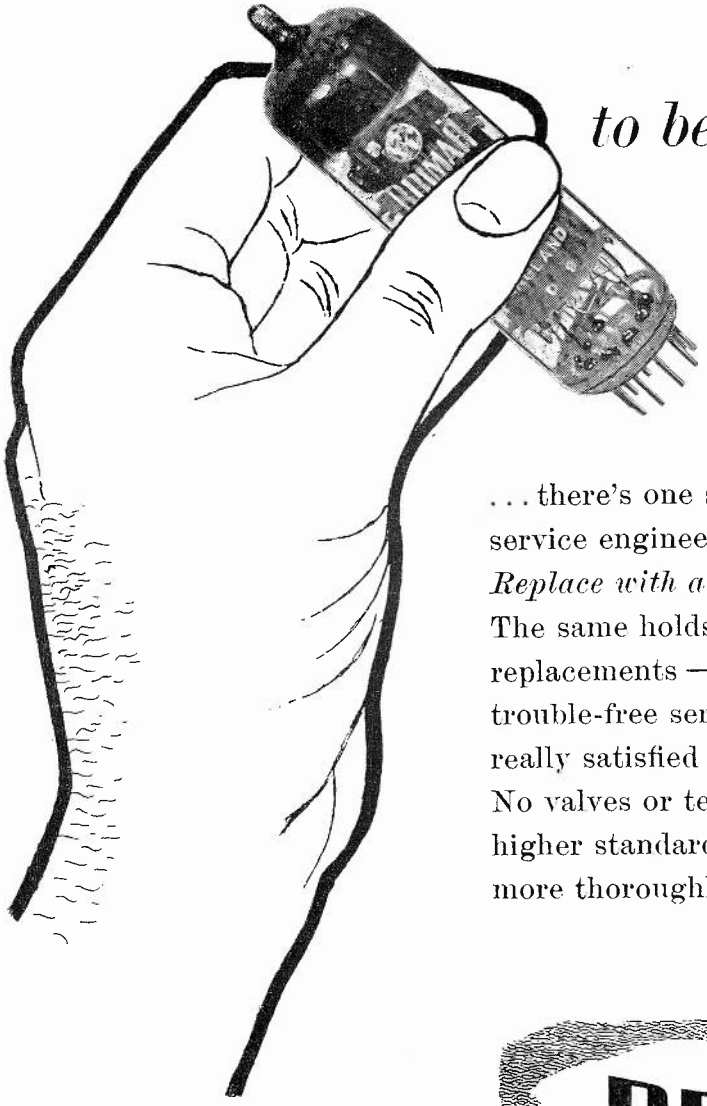
whenever *there's "just a valve"*



to be replaced . . .

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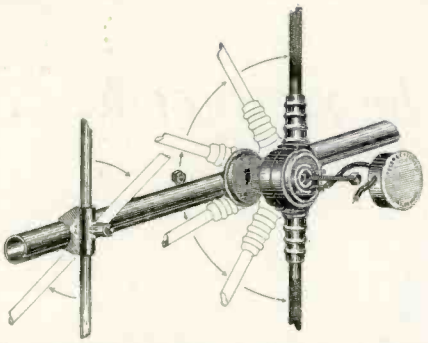

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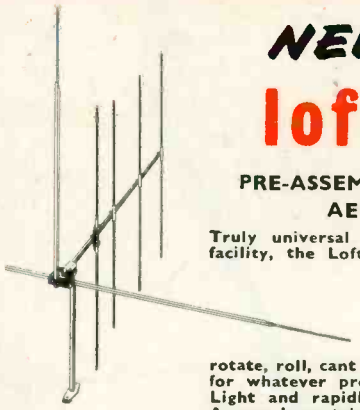

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